

Appl. No. : 10/706,346  
Filed : November 12, 2003

### AMENDMENTS TO THE CLAIMS

1. (Canceled) .

2. (Canceled)

3. (Currently Amended) The ~~cannula~~ system of Claim [[1]] 11, wherein the redirecting member is collapsible to cover the discharge opening during insertion.

4. (Currently Amended) The ~~cannula~~ system of Claim 3, wherein the redirecting member is collapsible to partially cover the discharge opening during insertion.

5. (Currently Amended) The ~~cannula~~ system of Claim [[1]] 11, wherein the redirecting member is actuatable to a pre-defined shape.

6. (Currently Amended) The ~~cannula~~ system of Claim [[1]] 11, wherein the tip portion comprises a plurality of discharge openings.

7. (Currently Amended) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough;

and

a tip portion extending from the main cannula portion to a distal end of the cannula, the tip portion comprising:

a plurality of discharge openings; and

a plurality of redirecting members each comprising an expandable member configured to expand under the pressure of the blood flow directed through the discharge openings such that at least a portion of the expandable member is spaced from the discharge opening by a greater amount than prior to such expansion, the expandable member presenting a concave redirecting surface to blood flowing through the discharge opening when expanded, the redirecting members configured to direct blood flow being discharged through the discharge openings proximally along the cannula ~~The cannula of Claim 6, wherein the tip portion further comprises a plurality of redirecting members configured to direct~~

blood flow being discharged through the discharge openings proximally along the cannula.

8. (Currently Amended) The cannula of Claim [[6]] 7, wherein the discharge openings are uniformly spaced radially around the tip portion.

9. (Currently Amended) The cannula of Claim [[6]] 7, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

10. (Currently Amended) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 9 a percutaneous cannula for discharging blood within a patient's vasculature, the percutaneous cannula fluidly linking the pump to the patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough, the blood flow lumen comprising a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature; and

a tip portion extending from the main cannula portion to a distal end of the cannula, the tip portion comprising:

a plurality of discharge openings; and

a redirecting member comprising an expandable member configured to expand under the pressure of the blood flow directed through the discharge opening such that at least a portion of the expandable member is spaced from the discharge opening by a greater amount than prior to such expansion, the expandable member presenting a concave redirecting surface to blood flowing through the discharge opening when expanded, the redirecting member configured to direct

blood flow being discharged through the discharge opening proximally along the cannula.

11. (Currently Amended) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

~~the cannula of Claim 1~~ a percutaneous cannula for discharging blood within a patient's vasculature, the percutaneous cannula fluidly linking the pump to a second vascular site, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough; and

a tip portion extending from the main cannula portion to a distal end of the cannula, the tip portion comprising:

a discharge opening; and

a redirecting member comprising an expandable member configured to expand under the pressure of the blood flow directed through the discharge opening such that at least a portion of the expandable member is spaced from the discharge opening by a greater amount than prior to such expansion, the expandable member presenting a concave redirecting surface to blood flowing through the discharge opening when expanded, the redirecting member configured to direct blood flow being discharged through the discharge opening proximally along the cannula.

12. (Currently Amended) The ~~cannula system~~ of Claim ~~[[1]]~~ 11, wherein the cannula further comprises a tapered portion proximate the distal end of the cannula.

13. (Currently Amended) The ~~cannula system~~ of Claim ~~[[1]]~~ 11, further comprising a surface extending across the blood flow lumen, the surface configured to direct blood through the discharge opening.

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14. (Currently Amended) The ~~cannula~~ system of Claim 13, wherein a guidewire lumen extends between the surface and the distal end.

15. (Currently Amended) The ~~cannula~~ system of Claim 14, further comprising sealing means configured to minimize the blood flow through the guidewire lumen when the cannula is in operation.

16. (Currently Amended) The ~~cannula~~ system of Claim 15, further comprising a valve located in the guidewire lumen.

17. (Currently Amended) The ~~cannula~~ system of Claim 15, further comprising a plug located in the guidewire lumen.

18. (Currently Amended) The ~~cannula~~ system of Claim ~~[[1]]~~ 11, further comprising a recess at the distal end of the cannula and configured to receive a guide-member.

19. (Currently Amended) The ~~cannula~~ system of Claim 18, further comprising a guide-member embedded in the recess.

20. (Currently Amended) The ~~cannula~~ system of Claim 19, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

21. (Currently Amended) The ~~cannula~~ system of Claim ~~[[1]]~~ 11, further comprising a gap extending between a proximal edge of the redirecting member and a proximal edge of the discharge opening through which blood may flow.

22.-85. (Canceled)

86. (Currently Amended) The ~~cannula~~ system of Claim ~~[[1]]~~ 11, wherein the expandable member has a distal end and a proximal end adjacent to a proximal end of the discharge opening, the proximal end of the expandable member comprising a continuous perimeter extending substantially entirely around the outside portion of the tip portion.

87. (Currently Amended) The ~~eannula~~ system of Claim ~~[[1]]~~ 11, wherein the expandable member has a proximal end with a perimeter, the expandable member having a contracted configuration in which the perimeter has a first length and an expanded configuration in which the perimeter has a second length, the second length being greater than the first length.

88. (Currently Amended) The ~~eannula~~ system of Claim ~~[[1]]~~ 11, wherein the tip portion is configured to direct blood flow in the direction generally opposite to the direction of blood flow in the lumen, and wherein the tip portion further comprises a surface extending across the blood flow lumen to direct blood through the discharge ~~openings~~ opening.

89. (Currently Amended) The ~~eannula~~ system of Claim 88, wherein the surface is curved.

90. (Currently Amended) The ~~eannula~~ system of Claim 89, wherein the surface is spherical or parabolic.

91. (Currently Amended) The ~~eannula~~ system of Claim ~~[[1]]~~ 11, where the redirecting member comprises a flap larger than the discharge opening.

92. (Currently Amended) The ~~eannula~~ system of Claim 91, wherein the redirecting member is collapsible to cover at least a portion of the discharge opening during insertion into the vasculature.

93. (Currently Amended) The ~~eannula~~ system of Claim 92, wherein a portion of the discharge opening is uncovered when the redirecting member is collapsed.

94. (Currently Amended) The ~~eannula~~ system of Claim 92, wherein the discharge opening is fully covered when the redirecting member is collapsed.

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95. **(Currently Amended)** The ~~cannula~~ system of Claim 92, wherein the redirecting member is collapsed onto a surface recessed into the outer wall of the cannula.

96. **(Currently Amended)** The ~~cannula~~ system of Claim ~~[[1]]~~ 11, wherein the redirecting member is expandable to uncover the discharge opening.

97. **(Currently Amended)** The ~~cannula~~ system of Claim 96, wherein a distal-to-proximal dimension of the redirecting member is smaller than a distal-to-proximal dimension of the discharge opening.

98. **(Currently Amended)** The ~~cannula~~ system of Claim 96, wherein a distal-to-proximal dimension of the redirecting member is approximately equal to a distal-to-proximal dimension of the discharge opening.

99. **(Previously Presented)** The cannula of Claim 7, wherein at least one of the redirecting members comprises an expandable member having a distal end and a proximal end adjacent to a proximal end of a corresponding discharge opening, at least two sides of the expandable member being connected to the tip portion.

100. **(Previously Presented)** The cannula of Claim 99, wherein the expandable member has a proximal end with a perimeter, the expandable member having a contracted configuration in which the perimeter has a first length and an expanded configuration in which the perimeter has a second length, the second length being greater than the first length.

101. **(Previously Presented)** The cannula of Claim 7, wherein the tip portion further comprises a surface extending across the blood flow lumen, the surface configured to direct blood through the discharge openings.

102. **(Previously Presented)** The cannula of Claim 101, wherein the surface is curved.

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103. (Previously Presented) The cannula of Claim 102, wherein the surface is spherical or parabolic.

104. (Currently Amended) The ~~cannula~~ system of Claim [[1]] 11, wherein the main cannula portion is comprised of a first material and the redirecting member is comprised of a second material.

105. (Currently Amended) The ~~cannula~~ system of Claim 104, wherein the second material comprises silicone.

106. (Currently Amended) The ~~cannula~~ system of Claim [[106]] 105, wherein the second material has a hardness of less than about 15 measured on an A scale durometer.

107. (Currently Amended) The system of Claim 11, wherein the A  
~~percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:~~

~~—— a main cannula portion comprising a blood flow lumen extending therethrough;  
and~~

~~—— a tip portion extending from the main cannula portion to a distal end of the cannula, the tip portion comprising:~~

~~—— a discharge opening having has a first area; and~~

~~a redirecting member with at least a portion configured to expand under the pressure of the blood flow directed through the discharge opening, the redirecting member configured to direct blood flow being discharged through the discharge opening proximally along the cannula; and~~

~~wherein the portion expandable member of the redirecting member that expands presents a second area greater than the first area when expanded.~~

108. (Currently Amended) The ~~percutaneous cannula~~ system of Claim 107, wherein the ~~portion of the redirecting~~ expandable member that expands has a proximal end with

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a perimeter, the expandable member having a contracted configuration in which the perimeter has a first length and an expanded configuration in which the perimeter ~~perimeter~~ has a second length, the second length greater than the first length.

109. (Currently Amended) The ~~puncture-cannula~~ system of Claim 107, wherein the ~~portion of the redirecting~~ expandable member ~~that expands~~ extends continuously around the outside perimeter of the tip portion.